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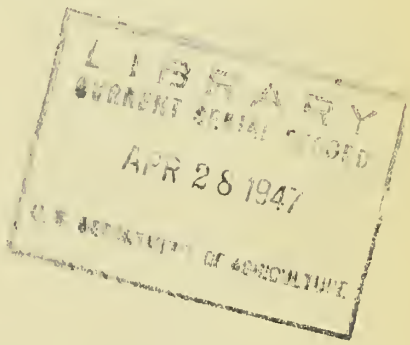
UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Plant Industry, Soils,
and Agricultural Engineering

H. T. & S. OFFICE REPORT NO. 173

SALTING PRACTICES IN FAN AND OVERHEAD BASKET BUNKER CARS LOADED WITH PRECOOLED CHERRIES



By

Fisk Gerhardt, Physiologist, and
A. Lloyd Ryall, Horticulturist

Washington, D. C.
July 21, 1946

SALTING PRACTICES IN FAN AND OVERHEAD BASKET BUNKER CARS LOADED WITH PRECOOLED CHERRIES 1/

Object:

This test was conducted to determine the salting practice necessary to insure adequate refrigeration for sweet cherries during transit. It is common practice to use salt for refrigeration in transit on the basis of a percentage of the ice added. In this study a comparison was made of commodity temperatures when salt was added either on the basis of the quantity of ice supplied or with stated amounts at each reicing. A comparison was also made of commodity temperatures in a 40 ft./car and a 50 ft. overhead bunker car that received salt at the same rate.

Outline of test:

Five 40-foot end bunker cars equipped with Preco fans and one 50-foot overhead basket bunker car were used in this study as follows:

Car No.	Type	Salting Practice
WFE 66568	Fan	3% initial salt - 3% all reicings
WFE 66566	"	4% " " - 4% " "
WFE 66567	"	1-1/2% " " - 70 lbs. " "
WFE 66565	"	1-1/2% " " -100 " " "
WFE 66569	"	1-1/2% " " -140 " " "
FOBX 4073	Overhead	4% " " - 4% " "

Commodity temperatures were taken at 12 positions in each car by means of electric resistance thermometers located as follows: top, middle, and bottom layers along centerline at the bulkhead, quarterlength, and doorway, and in the same layers at the doorway, south side.

The fan cars were all of similar construction and all cars in the test had 3-1/2 inches of hairfelt insulation in the floor, 3 inches in the side and end walls and 3-1/2 inches of fibre glass in the roof.

1/ Grateful acknowledgement is made to the individual shippers who supplied the necessary fruit, to the Western Fruit Express Co. and Fruit Growers Express Co. who furnished the test cars and representatives to accompany the test to the Great Northern Railroad, Chicago, Burlington & Quincy Railroad and Erie Railroad and their representatives and to the following staff associates whose helpful cooperation made the test possible: Edwin Smith, C. O. Bratley, and J. Kaufman.

A Ryan recording thermometer was placed at the top bunker opening in each of the fan cars to record the temperature of the delivery air when the fans were in operation. In the overhead bunker car similar records were likewise obtained from Ryan thermometers placed at the duct opening beneath the floor racks and in the air return.

Results

Car loading:

All cars were loaded with sweet cherries at Wenatchee, Wash. on July 5 and 6 after initial icing on July 4. The cars were not initially salted until after loading. Details of loading are shown in table 1.

Icing and Salting:

All cars were shipped under standard refrigeration with salt added as shown in table 2. At unloading, the ice bunkers in all the New York cars were approximately seven-eighths full. One car, WFE 66566, went to Boston but no records were taken on it beyond Hornell; at that point it was reiced to capacity (see table 2).

The total salt added under billings of 70 and 100 pounds at each reicing approximated those in cars which received 3 and 4 percent salt respectively. The amount of salt added in transit, however, was materially greater in those cars which received a stated amount. With salt added at the rate of 140 pounds at each reicing, the total amount used was nearly three times as great as with additions at the rate of 3 percent. As will be shown in the discussion of commodity temperatures, the addition of 140 pounds of salt at each reicing was too heavy. In order to insure against freezing of the commodity in the car of this test handled according to this schedule of salting, it was necessary to omit salt at the last regular reicing.

When both cars were salted on the basis of 4 percent at each reicing, the overhead bunker car required more salt than the fan car. However, the bunker capacity of the former was also considerably greater than that of the latter.

Outside temperatures:

As shown in Figure 1 outside temperatures were moderate during the loading and transit period with minimums varying from 48° to 60° and maximums from 75° to 93°.

Air temperatures inside cars:

Recording thermometer records at the point of air delivery as shown in Figures 1 and 2 indicate that when 3 percent salt was used the air temperature approached 32° to 35° when the fans were in operation and rose to slightly above 40° when the cars were standing and the fans were not operating. Due to instrument failure no temperature record was obtained in the car supplied with 4 percent salt. In the car salted with 70 pounds at each reicing air was delivered at approximately 30° while the car was moving but it was up to 40° while standing. One hundred pounds of salt at each reicing resulted in air temperatures of 27° to 30° during fan operation, while with 140 pounds of salt at each reicing air was delivered at 22° to 30°.

A recording thermometer placed at the bottom of the side wall duct in the overhead bunker car showed air temperatures varying from 30° to 38° but it is possible that this record may have been influenced by brine splashed from the floor drain. Air temperatures at the air return varied from 40° to 44°.

Commodity temperatures:

Fruit temperatures in the various cars under test are shown in tables 3 to 8 inclusive. Maximum, minimum and average commodity temperatures for the cars are shown in graphic form in figures 3 to 8 inclusive.

Initial saltings of 3 and 4 percent resulted in a sharp drop in the average commodity temperature after loading (figures 3 and 4). The temperature reduction was greater with 4 percent salt than with 3 percent. There was a drop of 7.3° in the first 36 hours in the former car compared with 3.7° with 3 percent salt in the latter. During the remainder of the transit period commodity temperatures were very similar in the two cars.

Figure 5 shows that the temperatures during the first 50 hours with 1-1/2 percent initial salt and 70 pounds at each reicing were from 2° to 3° higher than those in the fan car with 4 percent salt. For the remainder of the transit period there was little difference in load temperatures in any of the cars (figures 3, 4 and 5).

As shown in Figures 6 and 7 average commodity temperatures were relatively high at loading. With initial saltings of 1-1/2 percent together with heavier saltings at each reicing, temperatures were reduced to 35° or lower within 48 hours. Neither of these cars showed the rise in commodity temperature between Williston and Willmar which was characteristic of the cars receiving less salt at reicings. In the car receiving 140 pounds of salt at each reicing average commodity temperatures were below 33° during a major part of the transit period.

This average dropped below 30° prior to the last reicing, at which time no further salt was added.

Figure 8 shows that there was little change in average commodity temperature in the overhead basket bunker car during transit. Average temperatures for the entire period as shown in Table 9 generally were from 6° to 8° higher than in any of the fan cars.

The results of this test show that the overhead basket bunker car requires considerably heavier salting than 4 percent to provide satisfactory transit temperatures for sweet cherries.

The temperature spread in all cars varied between 2° and 7° during the transit period. The greatest spread occurred as a result of terminal delays, when the fans were not in operation. The fruit tempefature was generally highest at the south side doorway position, but the minimum temperatures could not be associated with any given position.

The data in Figures 3 to 7 show that the average commodity temperatures decreased consistently from LaCrosse to destination. This probably can be explained by the fact that on the eastern portion of the route the icing stations were not so far apart and the running time was faster, which caused greater air movement within the cars.

Summary

These studies show that in precooled loads it was possible to obtain satisfactory transit temperatures for cherries in fan cars as a result of several salting practices. From a commercial standpoint, additions of salt based upon the percentage of ice melted gave as good commodity temperatures as when stated amounts of 70 and 100 pounds were used. Salting at the rate of 140 pounds at every reicing was too heavy for commercial use.

Heavy initial saltings of 3 and 4 percent reduced commodity temperatures below those maintained during the remainder of the transit period. Reducing the initial temperature to such an extent is unnecessary, especially when such shipments move through cool mountain temperatures. An initial salting of 1.5 percent of the bunker capacity followed by the use of stated amounts of 70 and 100 pounds at each reicing thereafter eliminated the possibility of excessively low commodity temperatures from the heavy charge of salt when added on the basis of percentage of the ice supplied.

The results of these tests indicate that unless undetermined amounts of salt greater than 4 percent are used in the overhead bunker car, it will be inferior to the fan car for the transport of cherries.

It was possible to obtain average commodity temperatures in fan cars during transit that were comparable to those in some of the best commercial storages.

Table 1

Items Observed						
Shipper						
Loading Point						
Final Destination	New York	Boston	New York	New York	New York	New York
Routing						
Date Loaded						
Time - Started						
Time - Completed						
Billed Weight						
No. Lugs						
Fruit Temp. (Loading)						
Fruit Variety						
Lugs loaded - Tier						
Lugs loaded - Side						
Dunnage Bulkhead						
Height of Load						
Space above load						
Stripping (strips)						
Papering						
Car Temp. - when loaded						
Car Temp. - when loaded						
Side wall air space						
Outside air temp. when loaded						

(1) Cartons with fiberboard side walls. Loaded crosswise of car. All other cartons standard wooden cherry lugs.

Table 1

Car Loading Data

Items Observed	Car Number: PFEX 66558	PFEX 66566	PFEX 66567	PFEX 66565	PFEX 66569	PGEX 4073
Shipper	Belle S Wade	J.E.Wade	J.E.Wade	Wen.Cold Stg	Northern Pt.	Senoia
Loading Point	Wenatchee	Wenatchee	Wenatchee	Wenatchee	Wenatchee	Wenatchee
Final Destination	New York	Boston	New York	New York	New York	New York
Routing						
Date Loaded	7-6-46	7-6-46	7-6-46	7-5-46	7-6-46	7-5-46
Time - Started	2:45 AM	6:45 AM	5:35 AM	9:00 AM	8:20 AM	1:30 AM
Time - Completed	11:15 AM	8:25 AM	6:45 AM	10:19 AM	11:30 AM	5:45 PM
Billed Weight	27,720 Lbs.	27,744 Lbs.	27,625 Lbs.	27,720 Lbs.	26,740 Lbs.	31,850 Lbs.
No. Lugs	1584	1632	1625	1584	1112 cherries 280 apps	1820
Fruit Temp. (Loading)	38.3 deg.	39.4 deg.	39.2 deg.	47.3 deg.	42.6 deg.	41.2 deg.
Fruit Variety	Cherries	Cherries	Cherries	Cherries	Cher's & Apps	Cherries
Lugs loaded - long	22	22	22	22	22	52
- wide	8	8	8	8	8	5 (1)
- high	9	9 & 10	9 & 10	9	9, 9 & 10	7
Dunnage Bulkhead	34"	34"	34"	34"	24"	18"
Height of Load	41"	41"	41"	41"	41"	32-1/2"
Space above load	30"	30"	30"	30"	30"	30" at wall
Stripping (strips)	3-5-7-9	3-6-9	3-6-9	3-6-9	3-6-9	3-5-7
Dunnage	30" Slkd 60" floor	None	None	None	None	None
Car Temp. - when opened	48 deg.	42 deg.	40 deg.	48 deg.	48 deg.	54 deg.
- when loaded	52 deg.	44 deg.	44 deg.	60 deg.	52 deg.	48 deg.
Side wall air space	2"	2"	2"	2"	2"	5-1/2"
Outside air temp. when loaded	78 deg.	64 deg.	60 deg.	72 deg.	78 deg.	84 deg.

(1) Cartons with fibreboard side walls. Loaded crosswise of car. All other carloads standard wooden cherry lugs.

Table 2

Icing and Salting Record

Station	Date 1946	Time	Car Number WFE 66568 3% Salt Ice lbs	WFE 66568 3% Salt Salt lbs	WFE 66566 4% Salt Ice lbs	WFE 66566 4% Salt Salt lbs	WFE 66567 70 lbs salt Ice lbs	WFE 66567 70 lbs salt Salt lbs	WFE 66565 100 lbs Salt Ice lbs	WFE 66565 100 lbs Salt Salt lbs	WFE 66569 140 lbs Salt Ice lbs	WFE 66569 140 lbs Salt Salt lbs	FOBX 4073 4% Salt Ice lbs	FOBX 4073 4% Salt Salt lbs
Wenatchee (Initial ice)	7/4	9:50pm	9600	---	9600	---	9600	---	9600	---	9600	---	11,500	---
Appleyard	7/6	1:30pm	1900	288	1900	384	2100	144	2700	144	2100	144	3,400	460
Billyard	7/6	11:59pm	1400	42	1600	64	1600	70	1400	100	1500	140	2,000	80
Whitefish	7/7	5:55pm MT	1100	33	1100	44	1400	70	1100	100	1500	140	1,900	76
Williston	7/9	12:45am	1600	48	1400	56	2500	70	2300	100	2500	140	1,200	48
Willmar	7/10	5:45pm	2100	63	2300	92	2300	70	3100	100	2900	140	4,800	192
N. LaCrosse	7/11	3:37pm	2300	69	2100	84	2000	70	2000	100	2400	140	3,000	120
Clearing	7/12	10:30am	1400	42	1800	72	1800	70	1700	100	1800	140	2,800	112
Marion	7/13	2:20am EP	700	21	900	36	800	70	900	100	1000	140	800	32
Hornel	7/13	8:18pm	1000	30	1100	44	1200	70	1200	100	1200	---	500	20
Initial ice used in precooling cars			1900	---	1900	---	2100	---	2700	---	2100	---	3,400	---
Initial salt added after loading			----	288	----	384	----	144	----	144	----	144	----	460
Ice and Salt added enroute			11,600	348	12,300	492	13,600	560	13,700	800	14,800	980	17,000	680
Total Ice and Salt added			13,500	636	14,200	876	15,700	704	16,400	944	16,900	1124	20,400	1140

Table 3. Commodity temperatures in transit - 1946

Car: [illegible] (Precooled, 3% initial salt, 3% at all reicings)

Station	Date	Time	Outside Air	T B Cl	T Q Cl	T D Cl	T D SS	M B Cl	M Q Cl	M D Cl	M D SS	B B Cl	B Q Cl	B D Cl	B D SS	Maxilin		Spd	Ave
[illegible]natchee	7-6	1:00P	84	35	37½	37½	38	32	34½	34	36½	32	34	33½	37	39½	32	7	35
Fillmard	7-6	10:1[illegible]P	64	33½	31	33½	36	32	31½	33	34	31	31	31	32	36	31	5	32
Crow	7-7	6:48A	64	32½	29	31	33	31	29½	32	31½	30	30	29	30	33	29	4	30
[illegible]Bluff	7-7	12:30P	76	32	29	31	32	31	29½	31	31	30	30	29	30	33	29	3	30½
[illegible]lton	7-7	9:30P	46	32½	30	33½	33½	31	30	31	32	29	31	29	32	33½	29	4	31
[illegible]wo	7-8	7:[illegible]A	64	32	30	31½	33	31	30	31	31½	30	30	29	31	33	29	5	31
[illegible]ow	7-8	8:30	62	33	32	33½	34	32	31	32½	33	31	32	31	33½	34	31	3	32½
[illegible]liston	7-8	1:0[illegible]	83	34	33	34	35	32	33½	33	36	32½	33	32	36	36	32	5	33
[illegible]ley	7-8	3:1[illegible]	87	34½	34	36	37	33	33	34	36	33	34	33	36	37	33	4	34½
[illegible]wood	7-9	:15P	76	35½	34½	36½	38	33	33	34	36½	33	34	33½	36	38	33	4	35
[illegible]ridge	7-10	4:25A	65	34½	34	35½	37	33	33	34	36	33	33	33	36½	37	33	3½	34½
[illegible]lmer	7-10	4:30P	68	36½	35½	37	39	35	34	36	38	35	35	35	39	39	35	4	36
[illegible]la	7-11	2:30A	66	36	35	36½	38	34	34	35	37	34	34½	34	37	38	34	4	36
[illegible]ton 32	7-11	9:40A	68	36½	36	37	38½	34½	34	36	37½	33	34	34½	37	39	33	5	37
[illegible]Lacrosse	7-11	2:30P	83	36	35½	36	37½	34½	34	35	36	33	34	33½	36	37	33	4	35
[illegible]verona	7-11	9:45P	77	36	34	35	37	34	33½	35	36	34	34	33	35	37	33	4	34½
[illegible]lorinda	7-12	9:35A	79	36½	34	36	37	34	33	34	36	33	34	33	36	37	33	4	35
[illegible]ington	7-12	9:10P	65	36	34	35½	37	34	33	34	35½	33	33	33	36	37	33	4	34½
[illegible]ent	7-13	9:[illegible]	78	35	33½	34	36	34	33	34	34½	33	33	33	34	36	32	4	33½
[illegible]sville	7-13	1:45P	82	34½	33½	34	35½	33	34	33½	34	33	33	31½	34	35½	31½	4	33½
[illegible]well	7-13	8:00	70	34½	33	34	36	33	33	33	34½	32	33	32	34	35½	32	3	33½
[illegible]mond	7-14	6:45	78	34½	33	34	35½	34	33½	34	34	33	33	33	34	35½	33	3	33½
[illegible]xd	7-14	3:[illegible]	81	35	33	34½	36	34	34	34	34	33	33	33	34	36	33	3	34

Table 4. Commodity temperatures in transit - 1946

Car: PFE 66566 (precooled, 4 initial melt, 4 at all reicings)

Station	Date	Time	Outside Air	T B C1	T C C1	T D C1	T D SS	T D C1	M C1	M D C1	M T SS	B B C1	B C C1	B D C1	B T SS	Max	Min	Spl	Ave
Wenatchee	7-6	9:10A	65	44	41	39	40	42	40	36½	39½	39	38	36½	37	44	36½	7½	39½
Billyard	7-6	10:20P	64	37	34	34	37	37	35	36	35	33	33	33	34½	37	33	4	35
Troy	7-7	6:45A	54	33½	30	32½	33½	33	32	34	32	31	30½	30½	33½	34	30	4	32
Whitefish	7-7	MT2:35P	76	33½	31	32	34	33	31½	31	32	30	31	31	32	34	30	4	32
Dalton	7-7	9:30P	46	33½	32	32½	34½	32	31	33	33½	30	31	31	33	34½	30	4½	32½
Havre	7-8	7:40A	64	31½	30	31½	32	31	30	32	31	30	30	30	31½	32	30	2	31
Glasgow	7-8	3:30P	86	33	32½	32	34	32	31½	33	34	32	31	32	34	34½	31	3	32½
Williston	7-9	12:05A	63	34	34	34	35½	32½	32	33	36	33	32½	33	36½	36½	32	4	34
Stanley	7-9	OT9:10A	67	34	34	34	36½	33	32½	34	36½	33	32	33	37	37	32	4½	34½
New Rockford	7-9	2:15P	76	36	35½	36	38	34	33½	35	38	34	34	35	39	39	33½	5	35½
Devil's	7-10	4:25A	65	34½	34½	34	37	35	33	35	36½	32	33	32	37	37	33	4	34½
Milnor	7-10	4:30P	68	36½	37	37	39½	35	34½	35	39	35½	35	35½	40	40	34½	5½	35½
Hols	7-11	2:30A	65	35	35	36	38½	35	34½	36	37	33	34½	34	37½	38½	34½	4	36
Dalton PF	7-11	9:40A	68	36½	37	38	39½	34	34½	36	37½	33	34½	35	39	39½	33	6	36
Minot Re	7-11	2:30P	83	36½	35½	36½	37	34	34½	36	37	34	34½	34	37	37	34	3	36½
Devils	7-11	9:45P	77	34	34	34	35	34	33½	34	35	34	33	33	35	35	33	2	34
Clearmo	7-12	9:30A	79	35	35	35	37	34	33½	35	36	33½	34	34	37	37	33½	4	35
Bridgeton	7-12	9:10P	68	34½	34	34	36½	33	33	34	35	32	33	33	36	36	33	3	34
Kent	7-13	T 9:45A	78	33½	32½	32½	35	33	32½	33	35½	32	32	32	33	35	32	3	33
Hardville	7-13	1:45P	82	33	32½	33	35	33	32	33	33½	33	32	32	34	35	32	3	33
Orrell	7-13	6:00P	70	33	32	32½	34	33	32	34	34	33	32	32	34	34½	32	2½	33

Table [illegible] Commodity temperatures in transit - 1946

Car: [illegible] PFEX 66567 (Precooled, 1[illegible] initial salt, 70 [illegible] s. each relcing)

Station	Date	Time	Out side Air	T B Cl	I Q Cl	L M Cl	I L SS	K Cl	M Q Cl	L D Cl	D D SS	B B Cl	B A Cl	B D Cl	E D SS	Max	Min	Std	Ave
[illegible]enatchee	7-6	9:00A	65	37½	43½	39½	42	35	40	40	38	36	39	35½	40	43½	35	3½	39½
[illegible]illyard	7-6	10:20P	64	37	36	38	40½	35	36½	39	37	35	36	36	37	40½	35	5½	37
[illegible]ro	7-7	6:45A	54	35	33	35	38	34	34½	37	35½	33	34	33	34	38	33	5	34½
[illegible]leflet	7-7	MT2:35P	76	34	33	34½	36½	34	34	36	35	33	34	32½	34	36½	32	4	34½
[illegible]alton	7-7	9:30P	46	35	34	35½	37	33	34	36	34½	32	33	33	35	37	32	5	34½
[illegible]avre	7-8	7:25A	64	33	31	33½	35	32½	32	35	33½	32	32	31	33	35	31	4	32½
[illegible]lasgow	7-8	3:30P	86	34	32½	34	35½	32	32½	35	34	32½	32½	32½	34	35½	32½	3	33½
[illegible]illiston	7-9	12:05A	62	34	34½	35	36½	33½	33	36	34	33	33	34	36½	36½	33	3½	34½
Stanley	7-9	9:10A	67	34½	34½	35½	37½	34	33½	37	34½	34	33½	34½	37	37½	33½	4	35.
[illegible]m Reid	7-9	1:11P	76	36½	36	36½	39½	34½	34	38	35	34	34	35	38	39½	34	4½	36
[illegible]eridge	7-10	4:2[illegible]	6[illegible]	35	34	36	38	34	37	37	36	34	35	34	37	39	34½	4	36
[illegible]illmar	7-10	4:30P	68	35	37	37	39	35	37	38	36	36	36	36	39	39	34	4	36½
[illegible]ls	7-11	2:30[illegible]	66	36	38	37	39	35	37	38	36	36	36	36	38	39	34	4	36½
[illegible]ton 2	7-11	[illegible]:40[illegible]	63	36½	37	37	39	34	36	38½	36	36	36	36	38	39	34	4	36½
[illegible]derosa	7-11	2:30[illegible]	85	36	36	37	38	35	35	38	36	36	36	36	37	38	34½	4	36½
[illegible]wana	7-11	3:-5P	77	36	34	35	37	34	37	37	35	34	34	34	37½	37	34	3	35
[illegible]lerin	7-12	9:30[illegible]	75	37	36	38	37½	37½	34	37	36	37	[illegible]	34	36	37	34	3½	35½
[illegible]ston 2	7-12	[illegible]:10[illegible]	64	36	34	37½	38	34	34	37	35	[illegible]	[illegible]	35	36	36	34	4	35
[illegible]ne	7-12	10:40[illegible]	75	34	[illegible]	34	36	34	37	36	34	33	33	33	34½	36½	33	4	34
[illegible]ondi Lin	7-13	1:40P	80	36	36	38	39	37	38	38	38	36	36	36	38	39	36	3	37½
[illegible]rold	7-13	8:10P	70	35	35	36	37	35	36	37	36	35	35	36	38	38	35	3	36
[illegible]ne	7-14	8:[illegible]	78	34	34	36	37	36	36	36	36	34	34	34	36½	37	34	4	35½
[illegible]rontonFd	7-14	3:40P	88	34	34½	36½	37	36	36	36	36	34	34	34	36½	37	34	3	35½

Table 7. Commodity number of [illegible] April - 1946

Car: NLX 65595 (recorded, [illegible] cut, 100 [illegible] each returns)

tion	Date	Time	Out side Air	T D 31	[illegible] 31	[illegible] 31	D Ss	31	32	71	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Min.	Sou	Ave
[illegible]ches	7-5	10:15P	70	49	49	52	49	48	47	49	50	47	47	47	48	52	48	11	47
[illegible]rd	7-6	11:30A	73	46	48	47	48	48	48	46	46	37	44	44	48	48	37	11	45
[illegible]d	7-6	10:45P	64	41	41	41	41	39	40	43	43	36	40	39	40	43	36	7	40
[illegible]	7-7	6:45A	54	33	35	37	40	36	35	41	41	30	35	35	37	42	33	6	37
[illegible]lia	7-7	12:30P	76	38	36	36	39	38	37	41	40	31	37	35	37	41	34	7	37
[illegible]	7-7	:30P	46	38	36	38	40	36	36	40	--	34	34	36	37	4	34	6	37
[illegible]	7-8	7:40	54	33	33	35	36	34	33	37	37	33	34	33	38	37	33	4	34
[illegible]	7-8	5:30P	86	36	34	37	37	34	34	37	37	33	34	34	36	37	33	4	36
[illegible]liston	7-9	12:00	63	36	38	37	38	35	34	37	38	34	34	33	38	39	34	5	36
[illegible]ley	7-9	9:10P	57	38	34	36	38	36	34	37	39	34	34	36	3	39	34	5	36
[illegible]	7-9	1:15P	76	36	36	37	39	37	35	37	40	34	38	37	40	40	34	6	36
[illegible]ridge	7-10	4:05	66	38	38	36	38	37	[illegible]	36	39	34	37	34	38	39	34	5	35
[illegible]r	7-10	4:50P	64	37	37	39	40	[illegible]	38	37	[illegible]	35	[illegible]	36	[illegible]	40	35	5	37
[illegible]	7-11	2:30A	64	35	36	37	[illegible]	[illegible]	[illegible]	37	38	34	38	34	38	39	34	5	36
[illegible] lf	7-11	1:40A	58	37	37	38	39	[illegible]	38	37	38	34	38	36	38	39	34	5	36
[illegible]eroes	7-11	2:00P	63	36	38	37	38	36	34	37	[illegible]	34	38	36	37	[illegible]	34	4	36
[illegible]e	7-11	9:45P	77	36	33	35	37	34	33	36	37	33	33	33	36	37	33	4	34
[illegible]ert	7-12	9:30A	79	38	38	36	37	33	33	36	37	31	32	32	34	38	31	6	34
[illegible]ington	7-12	9:10A	65	35	33	35	37	33	32	35	37	31	33	33	36	37	31	6	34
[illegible]	7-13	2:00P	76	33	31	33	[illegible]	31	31	34	35	31	31	31	34	35	31	4	32
[illegible]ville	7-13	1:45A	68	34	34	37	38	34	34	36	38	34	36	34	38	38	34	5	36
[illegible]rell	7-13	9:00A	70	32	31	33	34	32	32	33	36	31	33	31	33	36	31	5	33
[illegible]e	7-14	8:45A	78	31	29	30	32	30	29	32	34	29	30	29	32	34	29	5	30
[illegible]nton Rd	7-14	3:25P	68	32	31	33	33	31	30	33	34	30	32	30	33	34	30	4	32

Table 7 Commodity temperatures in transit - 1946

Car: WFEX 66569 (Precooled, 1-1/2% initial salt, 140 lbs. re-icings)

Station	Date	Time	Outside Air	TB Cl	TQ Cl	TD Cl	TD SS	MB Cl	MQ Cl	MD Cl	MD SS	BB Cl	BQ Cl	BD Cl	BD SS	Max	Min	Spd	Ave
Tomatchee	7-6	1:00P	81	42	40½	41	45½	39½	41	48½	48	38	39	41	44½	48½	38½	10	42½
Tillyard	7-6	10:10P	64	39	37½	39	44	38	38	43	44	36	35½	37	39½	44	35½	8½	39½
Troy	7-7	6:45A	54	36½	35½	36	40½	36	36½	38½	41	33	33½	33	35½	41	33	8	36½
Whitefish	7-7	12:35P	76	34½	33	35	38	34½	35	37	38½	32½	32½	33	34	38	32½	5½	34½
Kalton	7-7	9:30P	46	35	33½	35	37½	33½	35	36½	38	31½	32	33	34½	38	31½	6	34
Havre	7-8	7:40A	64	32½	30½	32½	34½	31½	33	33½	36	31	30	31	32½	36	30½	5½	32½
Glasgow	7-8	3:30P	86	33	31	33	34½	31	33½	33	35	31	31½	31½	32	35	31	4	32½
Williston	7-9	12:05A	63	32½	32	33	35	31½	33	33	35	32	31	32½	33½	35½	31½	4	33
Berley	7-9	9:10A	67	32½	32	33	35½	31	33	32½	35	31	31½	32	34	35½	31	4½	32½
Sherwood	7-9	8:[illegible]P	76	37	35	34	37	31½	33	33	36	31	31	32	35	36	31	5	33½
Coleridge	7-10	7:25A	62	32	31	33	34	31	32	32	35	31	30½	32	34	36	30½	5	32
Dilmer	7-10	4:30P	68	34½	33	35½	37	32½	34	34	37	33	33	34½	37	37	32½	5	34½
Wells	7-11	2:30A	66	34½	34	35	37	32½	33½	33	37	33	32	32½	36	37	32½	5	34½
Dayton Mt	7-11	9:40A	66	34	34	35	36	31	33½	33½	36	31	32	33	34½	36	31	5½	34
Lawrence	7-11	2:30P	83	33	33	34	35½	31½	33½	33	36	31½	32	32½	34½	36	31½	4½	33½
Havre	7-11	9:45P	77	33½	32½	33½	35½	32	33	33½	35½	32	31	32	33	35½	31	4	33
Fleering	7-12	9:35A	70	32½	32	33	34½	31	33	32	34	31	31	32	33	34	31	4	32
Continen	7-12	9:10P	65	32½	32	32½	34½	30½	32	31	34	30	30½	31	32	34	30	4½	32
Kurt	7-13	10:45A	78	30½	30	31	32½	30	31½	29	33	30	29½	29½	31	33	29	4½	30½
Shadville	7-13	1:45P	82	30	29	30	31	30	30	29½	32	29½	28½	29	30	32	29½	3½	30
Terrell	7-13	3:00P	70	29½	28½	30	30½	29½	30	29	31	29	28½	29	30	31	28½	2½	29½
Panama	7-14	8:45A	78	29½	29	30	31	29	30	29	31	29	28	29	30	31	29	3	29½
Fronte Rd	7-14	3:35P	88	30½	30	31	32	29½	30½	30	31	30	29	30½	31	31½	29	2	30½

Table 6. [illegible] in transit - 1916

Car: TOMX 4073 (precooled, I, initial salt, - at all reicings)

tratched	7-5	5:30P	78	41½	45	[illegible]	39	48½	47	36½	37	44½	44	37	38	47	36	11	41½
ylevard	7-6	11:00A	78	42½	44½	44	42½	45½	44	43	41½	45½	42½	42	42½	45½	41½	4	43½
tlward	7-6	10:00P	64	42½	41½	41½	39½	44	41	41	40	43½	42	40	39½	44½	39½	5	42½
ror	7-7	6:45A	54	--	40½	41	38½	44½	41	41	40	42½	42	41	39	44½	38½	6	41
itefish	7-7	[illegible]:30P	76	40	39½	40½	38½	44	39	41	39½	41½	42	39½	38½	44	38½	5½	40½
alter	7-7	9:00P	46	40	39½	40½	38½	43½	39	40½	39½	41	41½	39½	39	43½	38½	5	40½
vre	7-8	7:00A	64	40	39	40½	38½	43	39	41	39½	41	41½	40	39½	43	38½	4½	40½
lenow	7-8	3:30P	86	40	39½	40½	39½	43	39	41	40½	41	41½	40½	40	43	39	4	40½
llleton	7-9	12:05A	63	41	40½	41½	40	43	40½	41	41½	42	42	41½	42½	43½	40½	3	41½
nday	7-9	07:10A	67	41	40	41½	40½	43	40½	41	41½	41½	41½	41	42½	43	40	3	41½
ew Field	7-9	[illegible]:[illegible]P	76	42	41	42½	42	44	41	42	43	42½	43	42	42	45	41	4	42½
ckridge	7-10	4:[illegible]A	65	43	41	42	41	43	41	41	42	42	42	41½	42	44	41	3	42½
ller	7-10	4:30P	68	45	42	43	42	44	43	43	44	44	43	44	44	46	42	4	44
e	7-11	2:30A	66	44	40½	42	42	44½	42	43	43	43	42½	43	43	45	40	4	43
ton St	7-11	6:00A	68	42	40	41	42	44	41	42	42	42	42½	42	42	44	40	4	42
decrease	7-11	2:30P	83	42	42½	42	41	44	41	43	43	43	43	43	43½	44	40½	3½	42½
vonna	7-11	9:45P	77	42	41½	42	41	44	41	43	43	42	43	43	43	44	41	3	42½
herine	7-12	4:50A	79	41½	40	42½	41	43	41	43	43	41	42½	43½	43	43½	40	3½	42
mmet	7-12	9:10P	85	42	40½	42½	42	43½	41	43	43½	42	43	43	43	43½	40½	3	42½
nt	7-13	3:00A	78	41	40½	41	40	43	41	42	42	41	42	42	43	43	39	4	41
lville	7-13	2:45P	92	41	39½	41½	40	43	41	42½	42	41	42	42	42	43	39½	4	41½
mell	7-13	8:00P	70	41	40½	42	41½	43	42½	43	42	42	41½	42	43½	43½	40	4	42½
ephanie	7-14	9:45A	78	41	39½	41½	40½	43	41	42½	42	41½	42	42	42	43	39½	4	41½
rktonia	7-14	3:[illegible]P	88	41	[illegible]	41½	41	43	42	43	42	42	43	43	43	43	40½	4	42½

Table 9 Comparison of Fruit Temperatures in the Test Cars During Transit

Station	Date 1946	Time	Average Commodity Temperature of Load 1/					
					Precooled Loads			
			3% salt	4% salt	70 lbs salt	100 lbs salt	140 lbs salt	4% salt
			WFE 66563	WFE 66566	WFE 66567	WFE 66565	WFE 66569	WFE 66573
Wenatchee	(after loading)		35.3	39.4	39.2	37.5	42.6	41.2
Hillyard	7/6	10:15 am	32.6	35.0	37.0	36.6	39.2	42.2
Troy	7/7	6:45 am	30.7	32.1	34.7	37.4	36.2	41.0
Whitefish	7/7	2:35 pm MT	30.6	32.1	34.2	37.7	34.8	40.3
Wilton	7/7	9:30 pm	31.2	32.3	34.4	37.1	34.6	39.2
Havre	7/8	7:40 am	31.0	31.0	34.3	34.7	32.4	40.2
Glasgow	7/8	3:30 pm	32.5	32.7	33.5	35.2	32.7	40.6
Williston	7/9	12:05 am	33.8	33.9	34.5	35.1	33.9	41.5
Stanley	7/9	9:10 am CT	34.2	34.2	35.0	36.0	32.7	41.3
New Rockford	7/9	8:15 pm	35.1	35.6	35.8	36.9	33.0	42.7
Breckenridge	7/10	4:25 am	34.6	34.7	35.0	35.7	32.4	42.2
Willmar	7/10	4:30 pm	36.5	36.7	36.4	37.3	34.8	43.9
Minneapolis	7/11	2:30 am	35.6	35.8	36.2	36.5	34.4	43.0
Dayton's Bluff	7/11	9:40 am	35.7	35.9	36.2	36.6	34.0	41.9
La Crosse	7/11	2:30 pm	35.1	35.3	36.2	36.2	33.4	42.3
Savanna	7/11	9:45 pm	34.7	34.5	35.0	34.7	33.1	42.3
Glenring	7/12	9:35 am	34.8	34.9	35.1	34.7	32.6	42.0
Huntington	7/12	9:10 pm	34.7	34.1	35.0	34.2	31.9	42.4
Kent	7/13	9:45 am PT	33.7	33.0	34.0	32.7	30.7	41.7
Meadville	7/13	1:45 pm	33.5	33.0	33.2	32.0	30.0	41.7
Hornell	7/13	8:00 pm	33.7	33.0	32.1	31.4	29.5	42.2
Susquehanna	7/14	8:45 am	33.8	----	32.3	30.8	29.7	41.6
Croxton Yards	7/14	3:35 pm	33.9	----	32.3	31.6	30.5	42.3
Average temperature enroute			33.8	34.2	34.9	35.3	37.4	41.8

1/ Average of 12 positions in each car

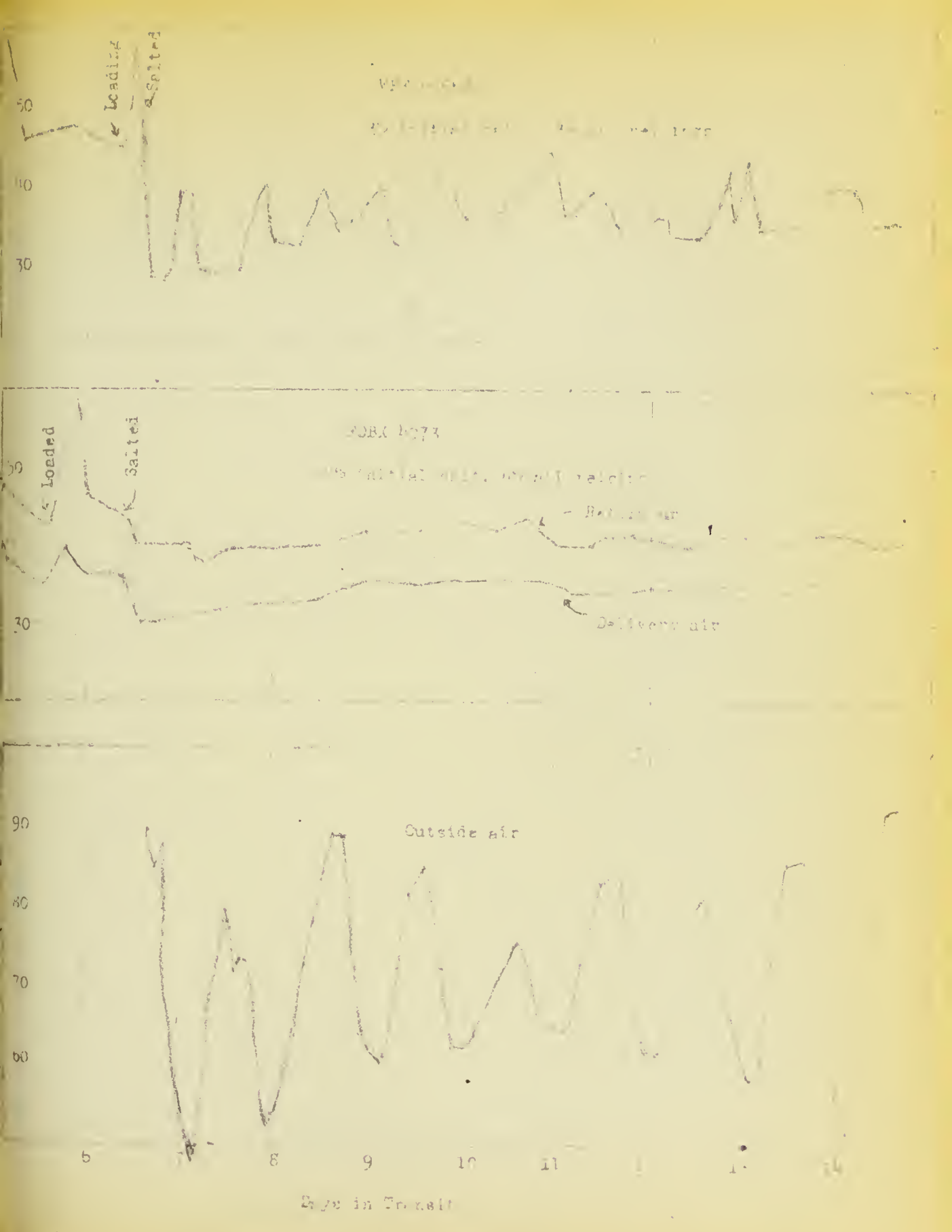


Figure 1. Car air and outside air temperatures

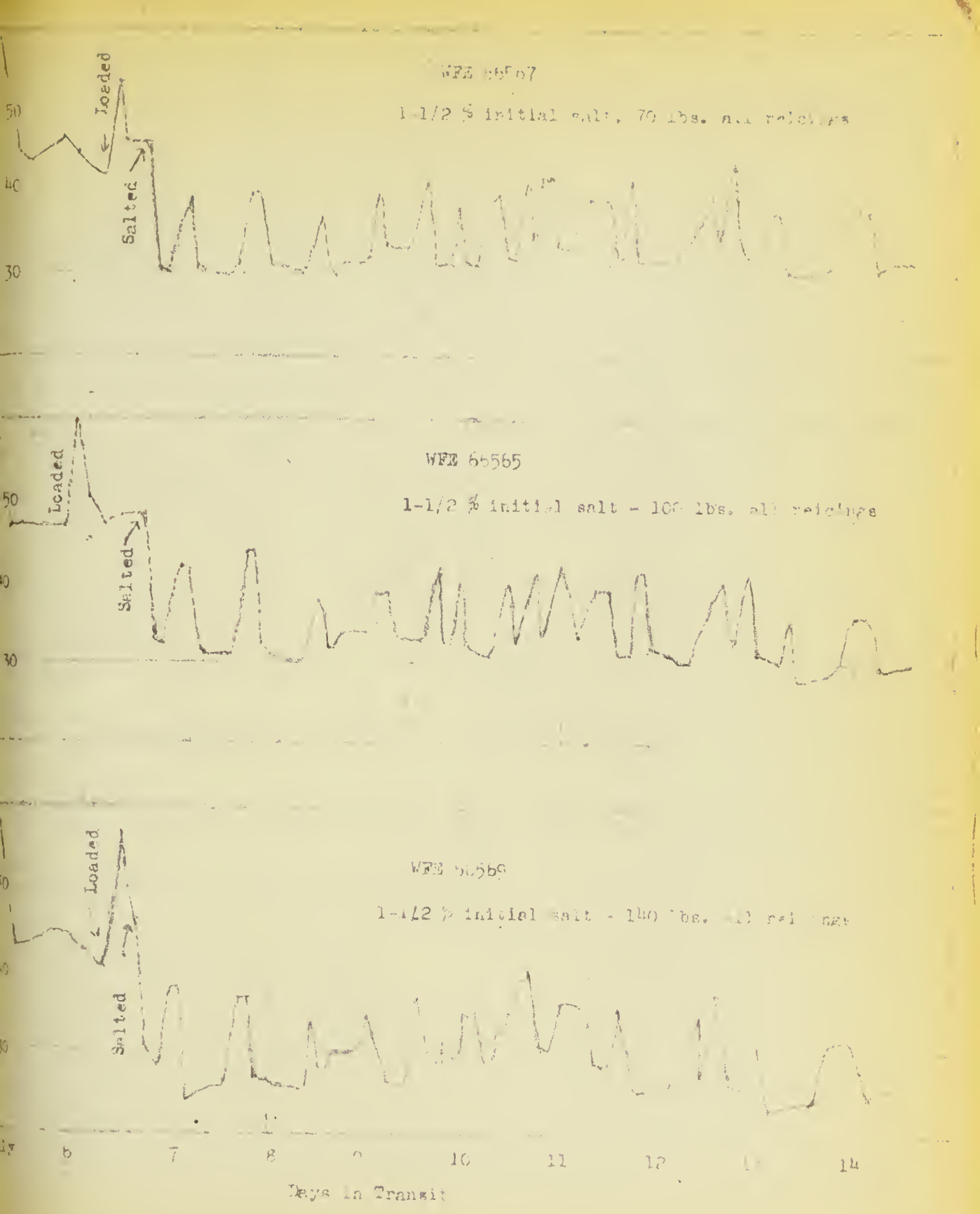


Figure 2. Air delivery temperatures in test cars

Figure 3 Maximum, Minimum and Average Commodity Temperature during Transit

Figure 4 Maximum, Minimum and Average Commodity Temperature during Transit

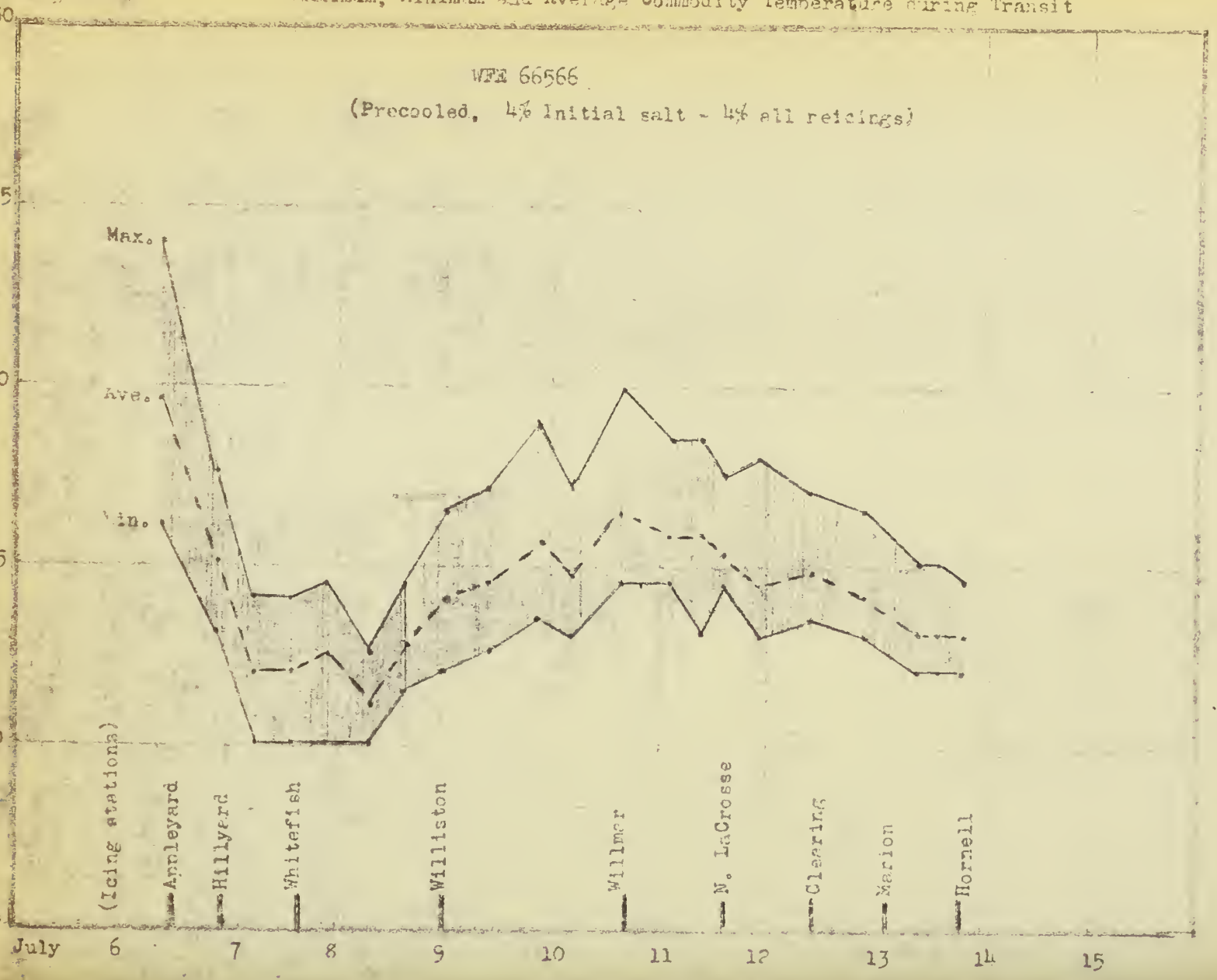


Figure 5 Maximum, Minimum and Average Commodity Temperature during Transit

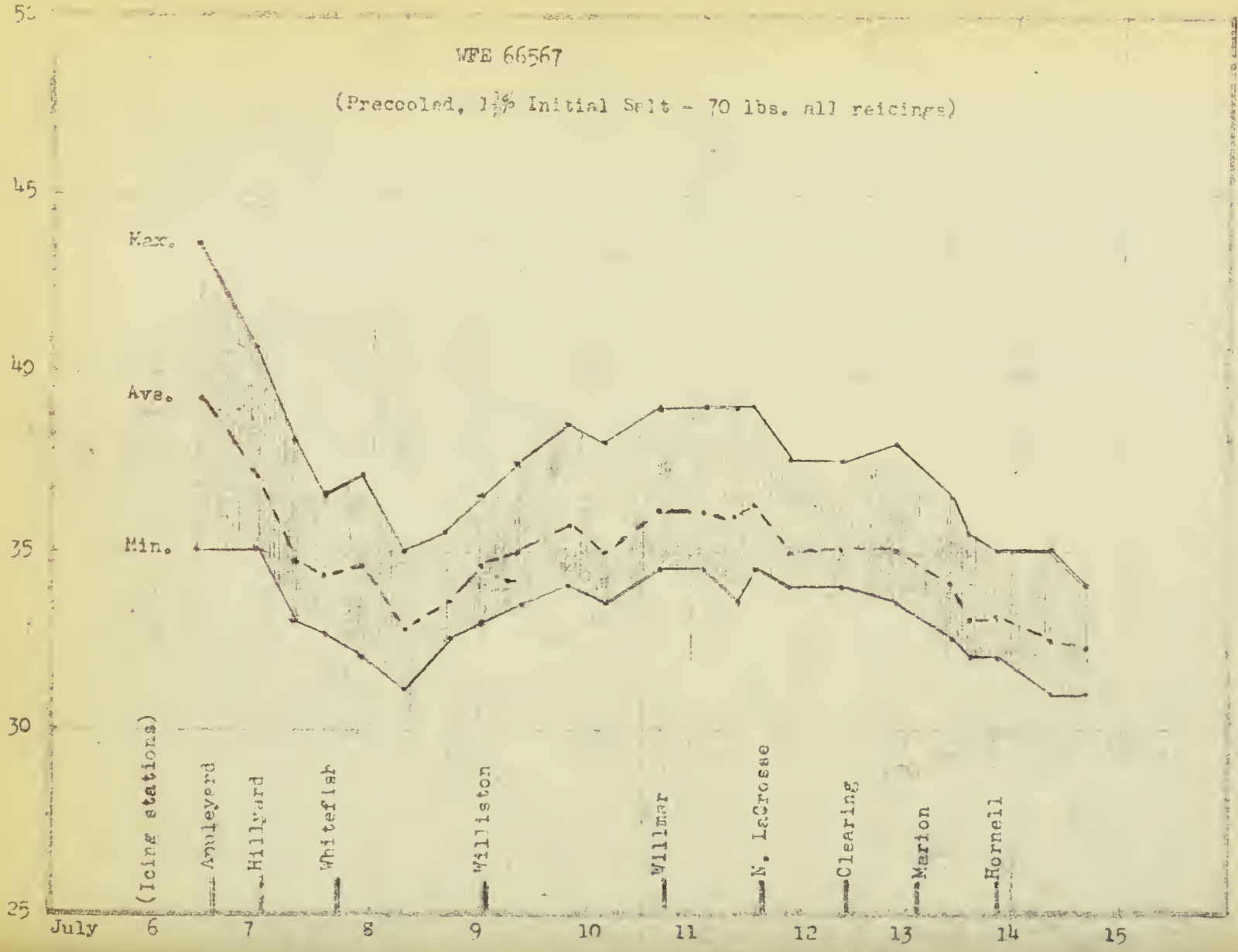


Figure 6 Maximum, Minimum and Average Commodity Temperature during Transit

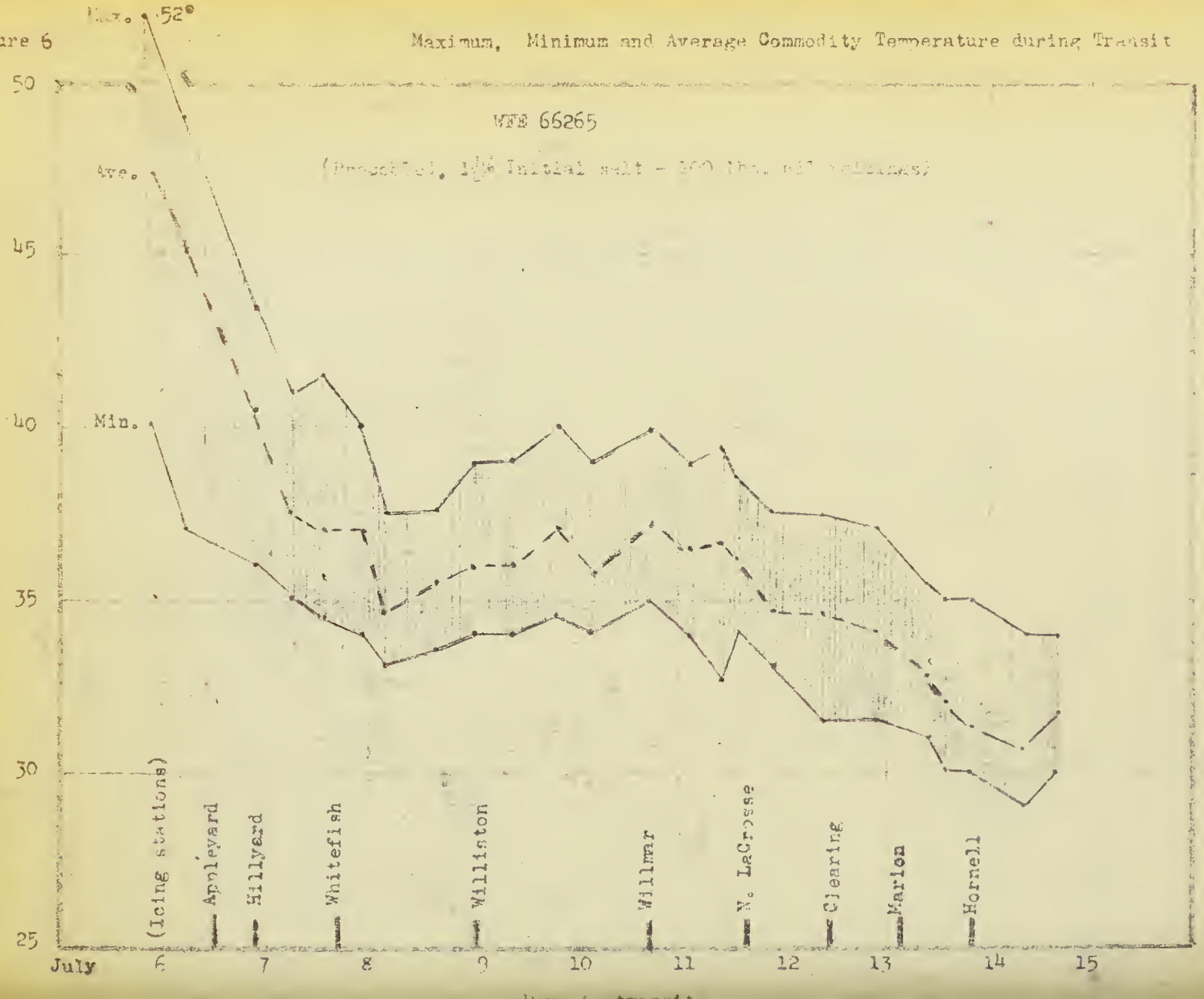


Figure 7 Maximum, Minimum and Average Commodity Temperature during Transit

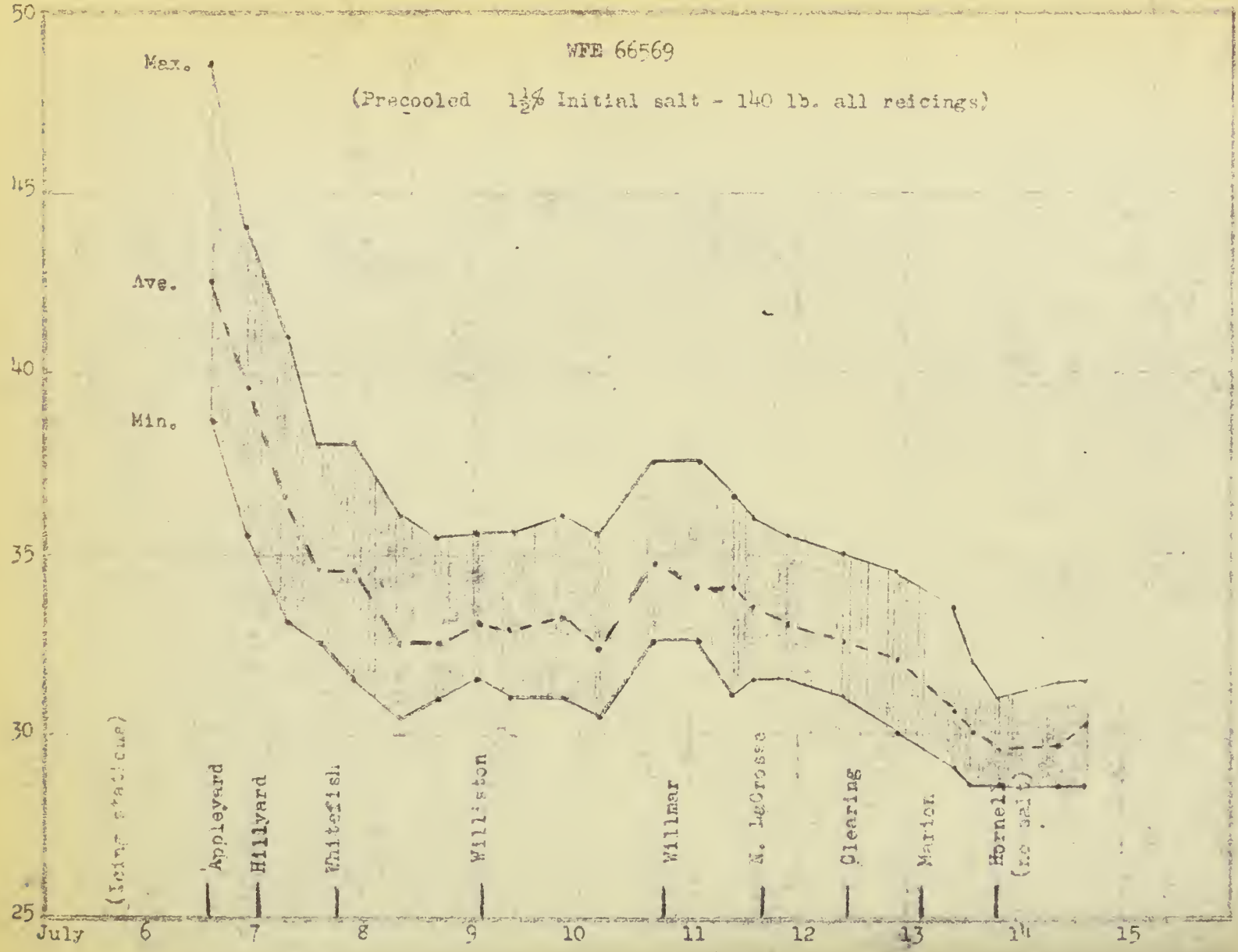
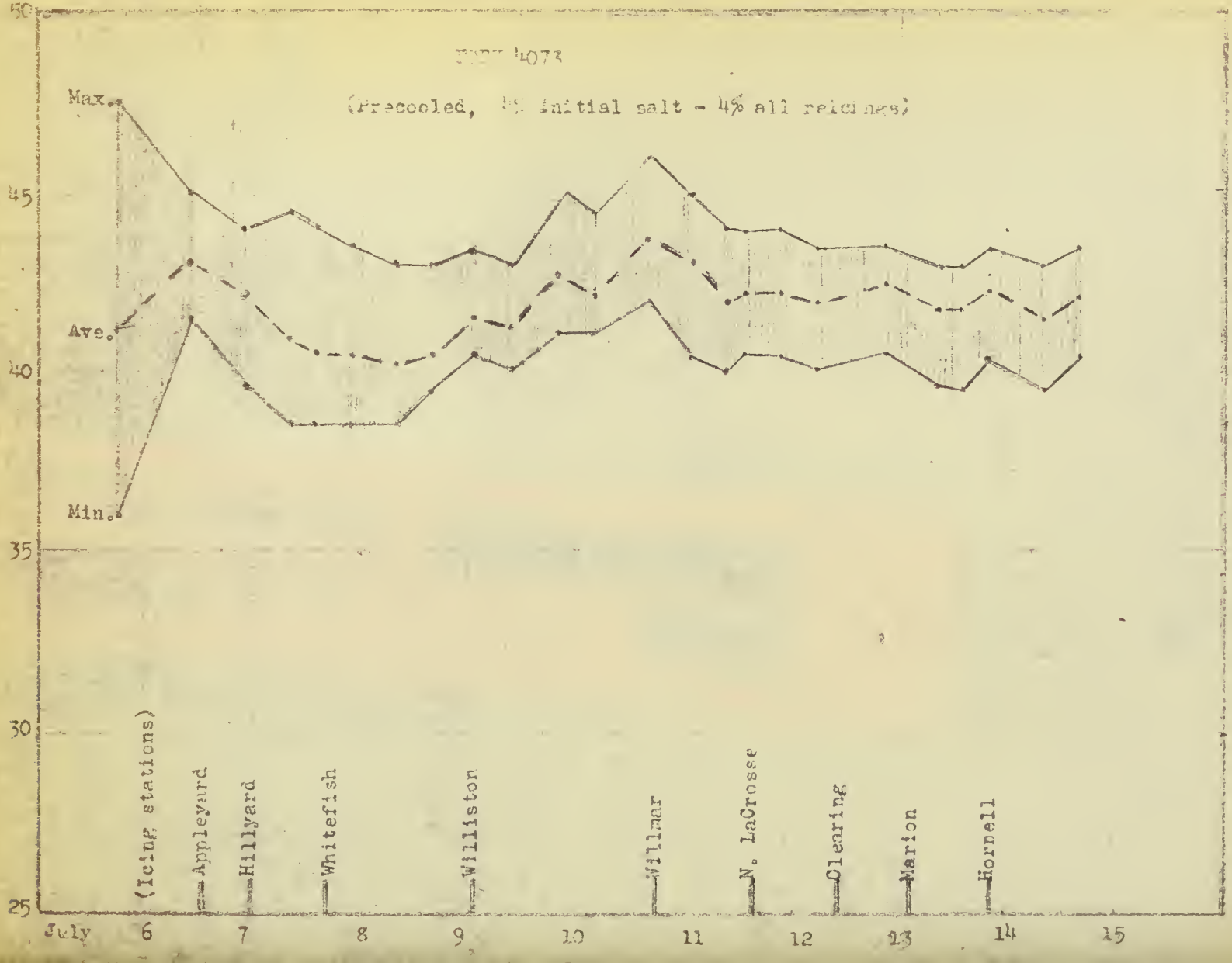



Figure 8 Maximum, Minimum and Average Commodity Temperature during Transit